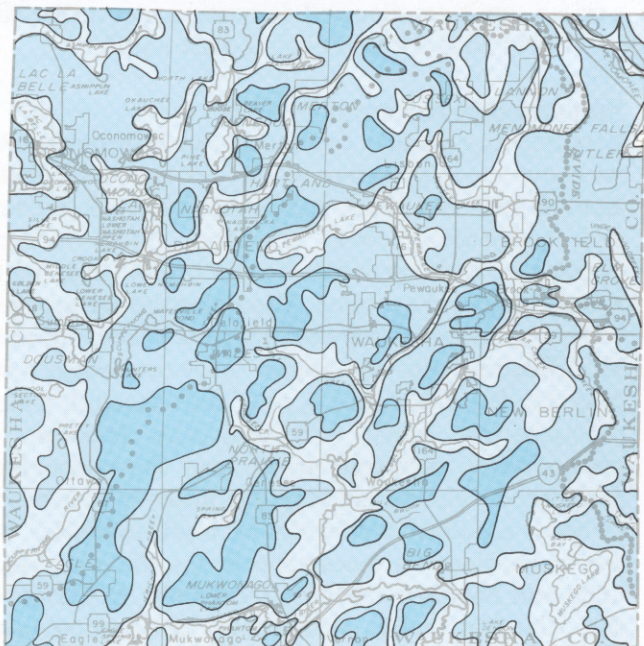


Map 21

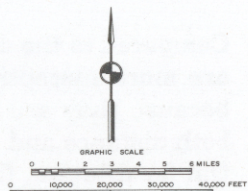
DEPTH TO SEASONAL HIGH GROUNDWATER LEVELS IN WAUKESHA COUNTY



LEGEND

DEPTH TO SEASONAL HIGH WATER

- GREATER THAN 30 FEET
- 10 - 30 FEET
- LESS THAN 10 FEET



Source: SEWRPC.

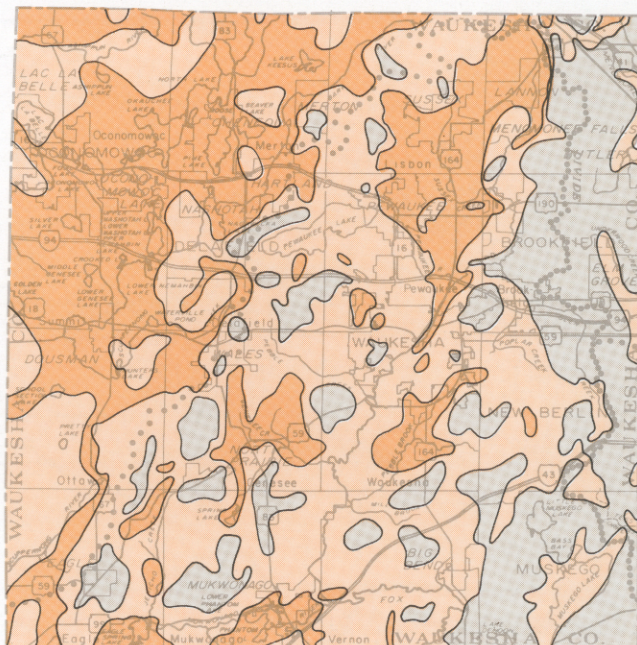
Radium Concentrations

Certain formations within the Cambrian sandstones in southeastern Wisconsin are known to produce relatively high concentrations of naturally occurring radium, a radioactive metallic element. This naturally occurring radium has been found to exceed U. S. EPA standards in approximately 50 of the 1,300 municipal water supplies in Wisconsin. Most of the water supplies which exceed the radium standard draw water from the deep sandstone aquifer and lie in a narrow band from the Illinois-Wisconsin border through Kenosha, Racine, and Waukesha Counties and north through Green Bay. Evaluations are being undertaken to consider means of reducing the radium level in these wells.

Systems serving the southern portion of the City of Brookfield, the City of New Berlin, the Village of Sussex, the Village of Mukwonago, the Village of

Map 22

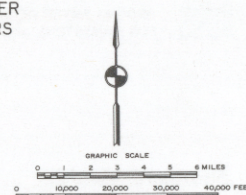
POTENTIAL FOR GROUNDWATER CONTAMINATION IN WAUKESHA COUNTY



LEGEND

CONTAMINATION POTENTIAL OF GROUNDWATER IN THE GLACIAL DRIFT AND NIAGRA AQUIFERS

- HIGH
- MODERATE
- LOW



Source: SEWRPC.

Eagle, and the City of Waukesha have reported some violations of the current five picocuries per liter Ra (pCi/l)⁶ EPA standard for radium (combined ²²⁶Ra and ²²⁸Ra). The EPA is currently re-evaluating this standard and may eventually permit greater concentrations than are permitted under current rules. The standard could possibly be revised to 15 or 20 pCi/l, which may bring some of the current violators into conformance.

SURFACE WATER RESOURCES

Surface water resources constitute an extremely valuable part of the natural resource base of

⁶A unit of measure of radioactivity.

Waukesha County. Surface waters are a focal point of water related recreational activities and provide an attractive setting for properly planned residential development. Surface waters, particularly the major lakes, also provide substantial economic benefits. Expenditures by boaters and other recreational users of surface waters benefit the owners of restaurants, grocery and convenience stores, service stations, and sporting goods stores in the County. Lakeshore properties, which generally have high assessed valuations, also serve to enhance the property tax base of the County. In addition, when viewed in the context of open space areas, surface waters greatly enhance the aesthetic and scenic characteristics of the natural environment. Because surface water quality is highly susceptible to deterioration from pollutant runoff, both urban and rural land uses must be carefully managed to achieve a balance between level and extent of use and the maintenance of water quality. Surface water resources in the County, consisting of lakes, streams, and associated wetlands and floodlands, are shown on Map 23 and described below.

Lakes

Major inland lakes are defined as those with a surface area of 50 acres or larger, a size capable of supporting reasonable recreational use with minimal degradation of the resource. Waukesha County contains all or portions of 33 major lakes with a combined surface area of approximately 14,000 acres, or 21.9 square miles, or about 3.8 percent of the total area of the County. This represents about 38 percent of the combined surface area of the 101 major lakes in the seven-county Southeastern Wisconsin Region, more than any other county in the Region. Thirty of the major lakes are located entirely within the County, while three major lakes, Lake Denoon, Golden Lake, and Lake Five, are located only partly within the County.

The major lakes in Waukesha County and their surface areas are presented in Table 34. As indicated in Table 34, the major lakes in the County range in size from 58 acres, Crooked Lake, to the second-largest lake in the Region, Pewaukee Lake, with a surface area of 2,493 acres. Seven lakes in the County have a surface area exceeding 640 acres, or one square mile.

Because lake water quality is significantly affected by surrounding land use and cover, urban development and agricultural activity on land that drains into lakes and streams has led to a decline in water

quality on many lakes in Waukesha County. Water quality often changes as a result of increasing levels of such nutrients as nitrogen and phosphorus entering a lake. Eutrophication is the condition reached by lakes when the accumulation of nutrients produces increasing amounts of aquatic plants. As the resulting lush aquatic plant growth dies each year, organic deposits fill in the lake. This is a natural process that is generally more prevalent in warm, shallow lakes, such as Big Muskego Lake, than in colder, deep lakes, such as Oconomowoc Lake. However, the process can be greatly accelerated by additional nutrients from inadequate or failing onsite sewage disposal systems, lawn fertilizers, agricultural runoff containing fertilizer and animal wastes, construction site runoff, and street debris.

An oligotrophic lake is one in which little of the eutrophication process can be measured. As a result of very little nutrient accumulation, there is little aquatic plant and algae growth and the water appears very clear. The lake is probably very deep and the bottom is sandy or marly. This type of lake will support such cold-water fish as trout. No such lakes are present in Waukesha County.



A mesotrophic lake shows some signs of eutrophication. The presence of a greater amount of nutrients than in an oligotrophic lake results in lowered clarity and the presence of aquatic plants. Swimming and boating can be enjoyed on this type of lake without limitations.

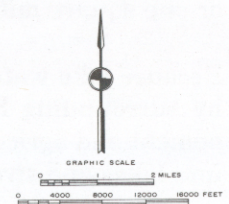
A eutrophic lake has relatively large amounts of aquatic plants because of higher nutrient levels. The water may be cloudy because of suspended algae cells, dying plants may produce unpleasant smells, and mats of plants may interfere with swimming and boating. These lakes are generally shallow, with mucky bottoms. Eutrophic lakes can be excellent warm-water fishing lakes for such fish as bass and bluegills.

The trophic status of most major lakes in Waukesha County is also presented in Table 34. The trophic state serves as an indicator of overall water quality, taking into consideration water clarity, phosphorus content, algae content, and regional location in Wisconsin. As indicated in Table 34, of the 33 major lakes in the County, two, Big Muskego Lake and Little Muskego Lake, were classified as eutrophic; nine lakes were classified as meso-eutrophic, or between mesotrophic and eutrophic rankings; 18

SURFACE WATER RESOURCES AND FLOODLANDS IN WAUKESHA COUNTY



-  WATERSHED BOUNDARY
 FLOODLANDS
 MAJOR LAKES



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Table 34

MAJOR LAKES IN WAUKESHA COUNTY

Lake Name	Surface Area (acres within Waukesha County)	Major Drainage Basin	Trophic State
Pewaukee	2,493	Fox	Meso-eutrophic
Big Muskego	2,177	Fox	Eutrophic
Okauchee	1,187	Rock	Meso-eutrophic
Lac La Belle	1,117	Rock	Mesotrophic
Nagawicka	957	Rock	Mesotrophic
Oconomowoc	767	Rock	Mesotrophic
Pine	703	Rock	Mesotrophic
Little Muskego	506	Fox	Eutrophic
North	437	Rock	Meso-eutrophic
Lower Phantom	433	Fox	Mesotrophic
Beaver	316	Rock	Mesotrophic
Eagle Spring	311	Fox	Meso-eutrophic
Upper Nemahbin	283	Rock	Meso-eutrophic
Lower Nemahbin	271	Rock	Meso-eutrophic
Lake Keesus	237	Rock	Mesotrophic
Silver	222	Rock	Mesotrophic
Golden	198 ^a	Rock	Mesotrophic
Lake Denoon	162 ^b	Rock	N/A
Upper Nashotah	133	Rock	Mesotrophic
School Section	125	Rock	Meso-eutrophic
Upper Phantom	107	Fox	Mesotrophic
Spring	105	Fox	Mesotrophic
Middle Genesee	102	Rock	Mesotrophic
Lower Nashotah	90	Rock	Mesotrophic
Ashippun	84	Rock	Meso-eutrophic
Moose	81	Rock	Mesotrophic
Fowler	78	Rock	Mesotrophic
Waterville Pond	68	Rock	N/A
Lower Genesee	66	Rock	Mesotrophic
Hunters	65	Rock	N/A
Pretty	64	Rock	Mesotrophic
Crooked	58	Rock	Mesotrophic
Lake Five	1 ^c	Rock	N/A
Total	14,004	--	--

NOTE: N/A indicates not available.

^aDoes not include 52 acres in Jefferson County.

^bDoes not include six acres in Racine County.

^cDoes not include 101 acres in Washington County.

Source: SEWRPC.

lakes were classified as mesotrophic; and four lakes could not be classified because of lack of data.

Sediments and associated substances delivered to lakes and streams in Waukesha County are a significant source of water pollution. Nutrients, in the form of fertilizers and animal wastes, are carried on eroded soil particles from agricultural and urban lands. This may cause the excessive growth of aquatic plants and thereby affect water clarity and increase oxygen demand. Streams may

Table 35

MAJOR WATERSHEDS IN WAUKESHA COUNTY

Watershed	Area (square miles)	Percent of Total Area of County	Major Drainage Basin
Fox River	336.3	57.9	Mississippi River
Rock River	193.5	33.3	Mississippi River
Root River	13.1	2.3	Great Lakes
Menomonee River	37.7	6.5	Great Lakes
Total	580.6	100.0	--

Source: SEWRPC.

exhibit a net deposition, a net erosion, or no net change in internal sediment transport, depending on the tributary land uses, hydrology, precipitation, and geology. Thus some streams are capable of removing sediments before they reach lakes.

Rivers and Streams

For flood control and water quality planning purposes, the Southeastern Wisconsin Regional Planning Commission has divided the Region into 11 major watersheds,⁷ four of which are located wholly or partially in Waukesha County. The subcontinental divide traverses the County in a north-south direction in the eastern tier of communities, separating the County between the Mississippi River and the Great Lakes-St. Lawrence River drainage systems. As shown on Map 23 and Table 35, two of the major watersheds, the Menomonee River and Root River watersheds, lie east of the subcontinental divide and are part of the Great Lakes-St. Lawrence River drainage system. The other two watersheds, the Fox (Illinois) and Rock River watersheds, lie west of the sub-continental divide and are part of the Mississippi River drainage area. As indicated in Table 35, the watershed covering the largest area of Waukesha County is that of the Fox River, encompassing about 58 percent of the total area of the County.

The subcontinental divide has important implications for the use of Lake Michigan as a source of potable water. In general, water from Lake Michigan may be piped to areas west of the divide only if

⁷A watershed is an area of land that drains runoff from precipitation and snowmelt to a lower point, such as a large lake or river.

Table 36

MAJOR STREAMS IN WAUKESHA COUNTY

Name	Length (miles)	Subwatershed	Major Watershed
Ashippun River	11.0	Ashippun	Rock
Bark River	31.8	Bark	Rock
Butler Ditch	2.4	Menomonee	Menomonee
Deer Creek	7.8	Upper Fox	Fox
Dousman Ditch	0.6	Menomonee	Menomonee
Fox River	46.1	Upper/Middle Fox	Fox
Genesee Creek and Spring Lake Outlet	13.5	Middle Fox	Fox
Jericho Creek	8.2	Mukwonago	Fox
Lilly Creek	3.3	Menomonee	Menomonee
Little Oconomowoc River	3.0	Oconomowoc	Rock
Mason Creek	3.8	Oconomowoc	Rock
Menomonee River	6.4	Menomonee	Menomonee
Mukwonago River	27.7	Mukwonago	Fox
Muskego Canal	3.7	Middle Fox	Fox
Nor-X-Way Canal	1.3	Menomonee	Menomonee
Oconomowoc River	12.2	Oconomowoc	Rock
Pebble Brook/Mill Brook	22.0	Middle Fox	Fox
Pebble Creek (Brandy Brook)	9.8	Upper Fox	Fox
Pewaukee River	6.4	Upper Fox	Fox
Poplar Creek	7.5	Upper Fox	Fox
Scuppernong Creek	15.0	Bark	Rock
Scuppernong River	13.5	Scuppernong	Rock
Sussex Creek	5.5	Upper Fox	Fox
Underwood Creek	4.2	Menomonee	Menomonee
Willow Creek	1.1	Menomonee	Menomonee
Total	267.8	--	--

Source: SEWRPC.

provision is made to return the spent water to the Lake. The diversion of water from Lake Michigan without provision for the return of the spent water is subject to complex Federal, State, and international legal and administrative restrictions, governed specifically by Sections 30.18, 30.21, and 144.026 of the Wisconsin Statutes and by Section 1109 of the Federal Water Resources Development Act of 1986. The subcontinental divide is thus an important consideration in the planning of public sanitary sewer and water supply facilities within the area, requiring the coordinated development of such facilities.

Major streams are perennial streams, which maintain, at a minimum, a small contiguous flow throughout the year except under unusual drought conditions. The major streams in Waukesha County are presented in Table 36 and are shown on Map 23. As indicated in Table 36, Waukesha County contains a total of approximately 268 miles of perennial streams. The longest major streams are the Fox (Illinois) and Bark Rivers, with 46.1 and 31.8 stream miles, respectively, in the County.

Floodlands

The floodlands of a stream are the wide, gently sloping areas contiguous with and usually lying on both sides of a stream channel. Streams occupy their channels most of the time. However, during even minor flood events, stream discharges increase beyond the capacity of the channel to accommodate the entire flow, especially where urban development increases runoff or alters the stream channel. As a result, stages increase and the river or stream spreads laterally over the floodlands. The periodic flow of a river onto its floodlands is a recurring phenomenon and, in the absence of costly flood control measures, will occur regardless of the extent of urban development in floodlands.

For planning and regulatory purposes, floodlands are normally defined as the areas, excluding the channel, subject to inundation by the 100-year recurrence interval flood event. This is the event that would be reached or exceeded in severity on the average of once every 100 years. It should be noted that the 100-year recurrence interval floodland contains within its boundaries the areas inundated

by floods of less severe but more frequent occurrence such as every five, 25, or 50 years. Floodlands are not suited to urban development because of flood hazards, high water tables, and inadequate soils. These areas are, however, generally suitable locations for valuable park and open space areas. Floodlands also provide storage for floodwaters and thereby decrease downstream flood discharges and stages.

Floodlands in Waukesha County, delineated by the Southeastern Wisconsin Regional Planning Commission, the Federal Emergency Management Agency, and the Wisconsin Department of Natural Resources, are shown on Map 23. The 100-year flood recurrence interval flood hazard area encompasses about 72 square miles, not including nearly 24 square miles of surface water in lakes and streams, or about 13 percent of the County's total land area. In 1990, a total of about 13.7 square miles, or about 19 percent, of these floodlands were located within state, county, or local public park and open space land.

WETLANDS

Wetlands are defined by the Regional Planning Commission as "areas that are inundated or saturated by surface water or groundwater at a frequency, and with a duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."⁸ Wetlands perform an important set of natural functions which make them particularly valuable resources lending to overall environmental health and diversity.

Wetlands contribute to the maintenance of good water quality, except during unusual periods of high runoff following prolonged drought, by serving as traps which retain nutrients and sediments, thereby preventing them from reaching streams and lakes. They act to retain water during dry periods and hold it during flooding events, thus keeping the water table high and relatively stable. They provide essential breeding, nesting, resting, and feeding

grounds and predator escape cover for many forms of fish and wildlife. These attributes have the net effect of improving general environmental health; providing recreational, research, and educational opportunities; maintaining opportunities for hunting and fishing; and adding to the aesthetics of an area.

Wetlands pose severe limitations for urban development. In general, these limitations are related to the high water table, and the high compressibility and instability, low bearing capacity, and high shrink-swell potential of wetland soils. These limitations may result in flooding, wet basements, unstable foundations, failing pavements, and failing sewer and water lines. Moreover, there are significant and costly onsite preparation and maintenance costs associated with the development of wetland soils, particularly in connection with roads, foundations, and public utilities.

Wetlands cover a combined area of 81 square miles in Waukesha County, or about 14 percent of the total area of the County. As indicated on Map 24, wetlands are scattered throughout the County. Large concentrations of wetland areas occur in the Vernon Marsh, along Scuppernong Creek and the Scuppernong River in the extreme western part of the County, at the headwaters of the Fox River in Menomonee Falls and City and Town of Brookfield, and surrounding Big Muskego Lake.

WOODLANDS

Woodlands have both economic and ecological value and can serve a variety of uses providing multiple benefits. Located primarily on ridges and slopes and along streams and lakeshores, woodlands provide an attractive natural resource, accentuating the beauty of the lakes, streams, and the topography of the County. In addition to contributing to clean air and water, woodlands contribute to the maintenance of a diversity of plant and animal life and provide for important recreational opportunities. Under balanced use and sustained yield management, woodlands can, in many cases, serve scenic, wildlife, educational, recreational, environmental protection, and forest production benefits simultaneously.

Waukesha County woodlands cover a combined area of 46 square miles, or 8 percent of the County's total land area. As indicated on Map 24, these woodlands exist in large contiguous areas along the Kettle

⁸For a descriptive analysis of the several definitions of wetlands used by Federal and State regulatory agencies, see Appendix A.